Canadian Centre for Occupational Health and Safety

Centre canadien d'hygiène et de sécurité au travail

ERGONOMICS FOR WORKPLACES WITH VISUAL DISPLAY TERMINALS

P89-22E

ERGONOMICS FOR WORKPLACES WITH VISUAL DISPLAY TERMINALS

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Canadian Centre for Occupational Health and Safety

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PREFACE

This publication is part of a series on ergonomics. It is prepared as a source of information for health and safety committees and others with an interest in understanding and reducing occupational risks of working with visual display terminals.

ERGONOMIC INFOGRAMS, shown as Appendices A-F, are available separately for display in the workplace (Set E-B).

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1. INTRODUCTION

Visual display terminals (VDTs) are now essential equipment in offices as well as in factories, banks, hospitals and many other workplaces.

VDTs, as with any other equipment, when used properly cause no adverse effects for the operator. But they can contribute to significant health and safety problems if they are used improperly or are poorly matched with the operator. The solution to such problems is to fit the workplace and working conditions to the physical and mental needs of the VDT operator.

The VDT itself is but one piece of equipment. It is important to consider the whole workplace, including the work station (chair, work surface, document holder), environment (lighting, temperature, humidity) and also the job design.

The VDT and the work station determine the operator's body positions and viewing distances. Lighting, humidity, noise and air temperature affect the operator's visual and physical comfort. The job design affects the mental and physical health of the operator through the variation in activities, body positions and work/rest schedules. Most problems occur when the majority of the work time is spent at the VDT doing repetitive tasks.

Each part of the workplace must complement the other parts. Changing any one may create the need for changes in the others. For example, if the chair height is lowered to improve the sitting position, the work surface may need to be lowered. Lowering this in turn may make the angle of the screen unsuitable. Likewise, changing the job design by switching from dictating equipment to paper copy will require a document holder and possibly a change in position of the keyboard.

2. HEALTH HAZARDS

The health problems related to VDTs are chiefly muscular and visual.

The muscular problems may include sore wrists, hand cramps, and pains in the neck, shoulders, back, arms and legs. The visual problems include eyestrain, burning and irritated eyes, watery and red eyes, blurred vision, double vision, headaches and dizziness. Such visual problems are sometimes hard to separate from general fatigue.

There are several causes for the muscular and visual problems, some of which follow.

Unadjusted Work Stations

Improper work station adjustment forces the operator to use awkward body positions which cause muscular problems. Also, visual problems may result if the operator must strain the eyes to see clearly. Unadjustable work stations make it impossible to match the positions of keyboards and screens to the operator.

Working with the Body in One Position for Long Periods of Time

To hold one body position, muscles must contract. This reduces blood flow to these muscles and leads to tiredness and pain.

Repetitive Movements

Using the small muscles of the hands repeatedly can lead to muscle strain, pain and, possibly, injury.

Poor Lighting

Too much light (glare) or too little light (shadow) contributes to visual problems. The operator may have to use an awkward body position to compensate for glare and shadows.

Repeated Focussing of the Eyes

Frequent switching of the eyes from a source document to the keyboard to the screen requires repeated focussing of the eyes. This contributes to eyestrain.

Lead Aprons

Lead aprons are not needed for protection against radiation from VDTs. The lead apron places unnecessary weight on the front of the body and can aggravate the postural problems of the VDT operator. (Refer to the CCOHS publication P88-15E, Health Hazards of Radiation From Video Display Terminals--Questions and Answers.)

3. PREVENTION

Well-designed workplaces and jobs contribute greatly to a VDT operator's health and comfort. In the design, selection and use of a VDT, these factors are especially important:

- adjustability of the work station including chair, document holder and lighting
- visual environment
- job design

Adjustability

Workers vary in size, shape and preferences. Work stations are often used by more than one worker. Work stations must therefore be adjustable. The following affect adjustments:

- Body size. The length of the leg determines chair height; sitting elbow height determines the work surface height; eye height determines the screen position.
- Task. The type of task being performed determines the best position of the keyboard, and the amount of space needed for source documents and auxiliary equipment.
- Individual preferences. Readjusting the work station and chair according to the VDT operator's preference throughout the workday helps to change body positions.
- Convenience. Adjustments should be possible from a seated position.

Visual Demands

VDT work is a visually demanding task. Glare and shadows, or long periods viewing the screen can contribute to eyestrain. Reducing sources of glare, taking advantage of work/rest schedules and varying work tasks reduce visual strain.

Uncorrected or improperly corrected eyesight can lead to great visual discomfort. Regular eye examinations will identify visual problems. The eye examiner should be informed about the VDT use and the viewing distances. People who wear bifocals can experience problems if the head is held in an uncomfortable position to view the screen. Alternative lenses should be considered.

Job Design

VDT jobs should be designed to encourage changing body positions by varying tasks. Good work/rest schedules give the muscles, the eyes and the mind a chance to rest and recover.

4. CHOOSING VDTs AND WORK STATIONS

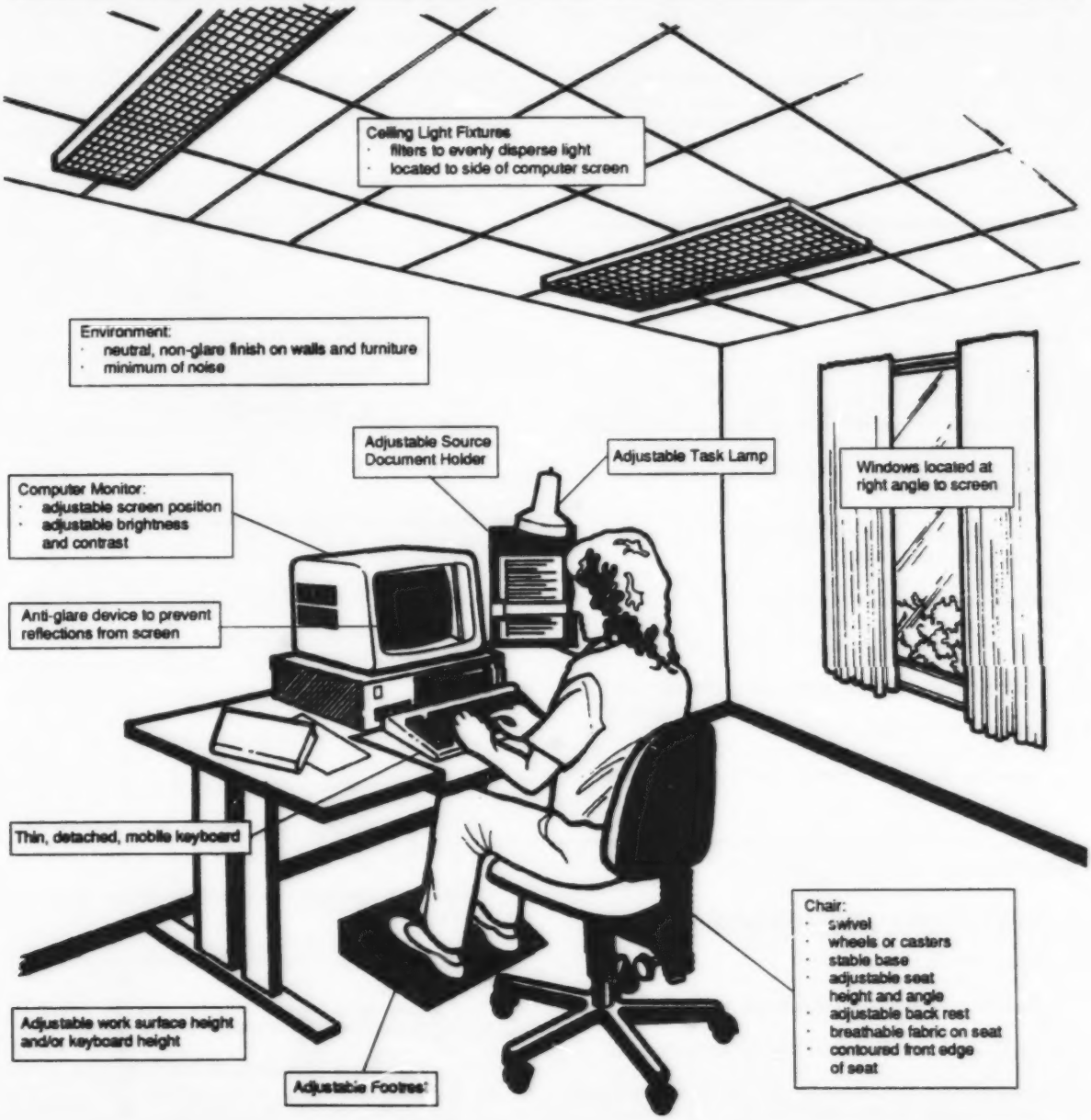
Sometimes makeshift adjustments to a work station are made. An uncomfortable operator may use a wedge under the front of a screen to change the angle. In the same way, a box or telephone book is used instead of a properly adjustable footrest. This type of temporary arrangement is an obvious indicator of problems.

It is best if VDTs and their work stations have certain features built-in. Selecting equipment with as many of the desirable components as possible, as shown in ERGONOMIC INFOGRAM E-B01, is very important. No amount of retrofitting will make up for poor design.

Refer to the Appendices A-F for detailed guidance on setting up and using a VDT work station.

APPENDIX A

VDT Workplace


Ceiling Light Fixtures
· filters to evenly disperse light
· located to side of computer screen
Environment:
· neutral, non-glare finish on walls and furniture
· minimum of noise
Adjustable Source Document Holder
Adjustable Task Lamp
Windows located at right angle to screen
Computer Monitor:
· adjustable screen position
· adjustable brightness and contrast
Anti-glare device to prevent reflections from screen
Thin, detached, mobile keyboard
Chair:
· swivel
· wheels or casters
· stable base
· adjustable seat height and angle
· adjustable back rest
· breathable fabric on seat
· contoured front edge of seat
Adjustable work surface height and/or keyboard height
Adjustable Footrest

Available for display as ERGONOMIC INFOGRAM E-B01

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APPENDIX B

Checklist

VDT workplaces must be flexible enough to accommodate the various individuals using them.

Use this checklist to identify problems in a VDT workplace.

"NO" answers indicate a potential problem and should be followed up. They may indicate the need for adjustment or changes in the workplace or job design.

VDTS

___ Top surface of the keyboard space bar (or bottom row of keys) is no higher than 6.5 cm (2.5 in.) above the work surface.

___ During keyboard use, the forearm and upper arm form an angle of 80°-100°, with the upper arm almost vertical. The wrist is relaxed and not bent. Wrist rests are available.

___ If used primarily for text entry, keyboard is directly in front of the operator.

___ If used primarily for data entry, keyboard is directly in front of the keying hand.

___ Keyboard is detached and moveable.

___ Top of the screen is about eye level.

___ Viewing distance is 30 to 60 cm (12 to 24 in.).

___ Screen is free of glare or shadows.

___ Images on the screen are sharp, easy to read and do not flicker.

Chair

___ Chair has wheels or castors suitable for the floor surface.

___ Chair swivels.

___ Backrest is adjustable for both height and angle.

___ Backrest supports the inward curve of the lower back.

___ Chair height is appropriate for the individual and the work surface height. Refer to ERGONOMIC INFOGRAM E-B04.

___ Chair is adjusted so there is no pressure on the backs of the legs, and feet are flat on the floor or on a foot rest.

___ Chair is adjustable from the sitting position.

___ Chair upholstery is a breathable fabric.

___ Footrests are used if feet do not rest flat on the floor.

Work Surface

___ Work surface height is adjustable.

___ Leg room is sufficient to change position of legs without getting up.

___ Work surface is large enough to hold work materials.

___ Commonly used items are close to and in front of the operator.

___ Infrequently used items are stored.

Visual Environment

___ Lighting does not produce glare or shadows on the screen.

___ Lighting allows workers to easily read characters on the screen and source document.

___ Wall colour is neutral and not too bright.

___ Shiny surfaces and objects are covered or removed.

___ Windows have blinds or curtains to prevent glare.

___ VDTs are located away from windows, or screens are at a 90° angle to windows.

___ Ceiling fluorescent lights are oriented lengthwise to the sides of the VDT.

___ Room lighting is uniform and slightly dimmer than usual office lighting.

___ General work areas have indirect or diffuse lighting.

___ Ceiling fluorescent lights are fitted with diffusers or parabolic louvres.

___ Adjustable task lights are available over source documents.

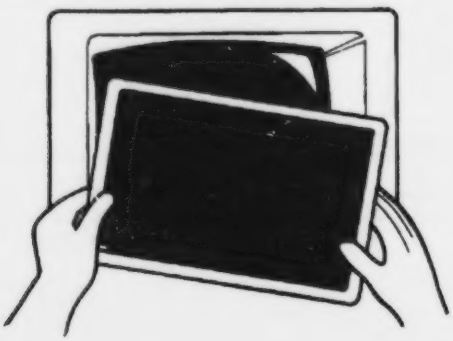
Available for display as ERGONOMIC INFOGRAM E-B02

APPENDIX C

VDTs

VDTs come with various features that are built in or that can be added. Use the adjustments provided.

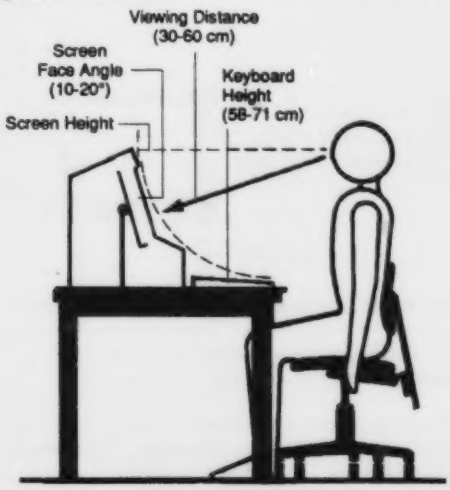
ELIMINATE glare caused by lights, windows or bright objects. If reflections can still be seen on the screen, use a mesh filter or anti-glare spray. Follow the manufacturer's instructions. Refer to ERGONOMIC INFOGRAM E-B05.



ADJUST screen brightness and contrast. It is easier to read from the screen if characters are brighter than the background. Be careful not to make characters too bright.

ADJUST the screen height so the top is just about eye level.

TILT the screen slightly backwards. Watch that this does not create glare on the screen.

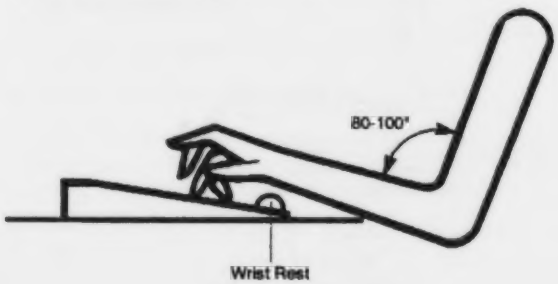


ADJUST chair, work surface and keyboard heights properly. Refer to ERGONOMIC INFOGRAM E-B04.

POSITION keyboard for two-handed "typing" directly in front of operator. Position keyboard for one-handed data entry in front of keying hand. Leave a large area free for source documents and other work materials.

MOVE the keyboard occasionally to change the arm and shoulder position.

USE a wrist rest if the heel of the hand or wrist is not supported.



USE an adjustable document holder. Place it next to the screen and at the same height. The head will have to turn less and eyes will adjust more easily. Refer to ERGONOMIC INFOGRAM E-B01.

ALTERNATE position of document holder on either side of VDT to change head position.

CONNECT keyboard to VDT with a cord that is at least 70 cm (28 in.) long.

CHECK for excessive noise from the VDT or printer.

CLEAN the VDT screen regularly. Follow the manufacturer's instructions.

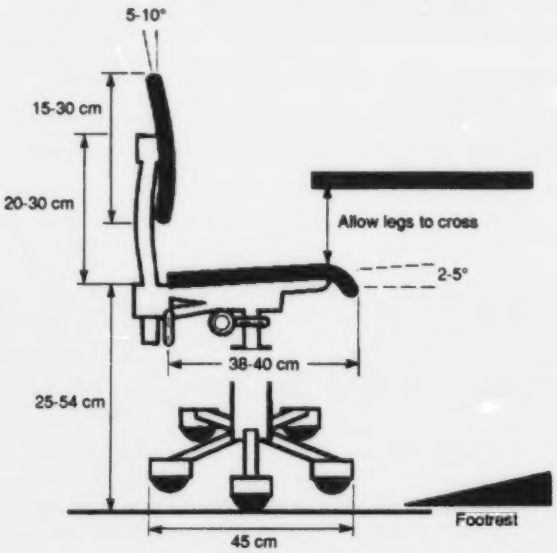
REPORT problems with VDT controls, flicker or excessive noise.

Available for display as ERGONOMIC INFOGRAM E-B03

APPENDIX D

Chair and Work Surface

Well-adjusted chairs improve body position and blood circulation, reduce muscular effort, and decrease pressure on the worker's back. Chairs should swivel, have five wheels for stability, have a breathable fabric on the seat, and have a rounded front edge.



TIGHTEN the chair backrest so that it does not give way with body weight.

READJUST the chair throughout the day to vary body position.

USE only chairs with arms that do not interfere with the work surface.

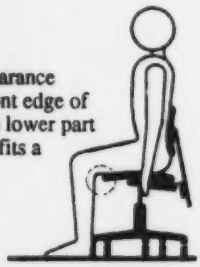
CHECK that there is enough leg room under work surface. Do not store materials under work surface.

CHECK that the work surface is large enough to hold work materials.

STORE items not used frequently.

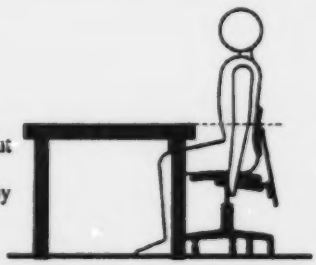
Adjustable work surfaces provide the most flexibility and accommodate the largest number of users. Adjust chair according to body size, then adjust work surface or keyboard height.

STAND in front of the chair. Adjust the height so that the highest point of the seat is just below the knee cap.



SIT so that the clearance between the front edge of the seat and the lower part of the legs just fits a clenched fist.

ADJUST the backrest of the chair so that it supports the hollow in the lower back.



ADJUST work surface to about the height of elbows with the arms hanging straight by the sides.

If temporarily using an unadjustable work surface:

ADJUST seat height so that elbows are about the same height as the home row on the keyboard.

USE a footrest if there is pressure on the back of the legs or if the feet are not resting flat on the floor. The footrest should support the whole foot and be adjustable.

Available for display as ERGONOMIC INFOGRAM E-B04

APPENDIX E

Visual Environment

Reflections from light fixtures, windows, or shiny objects cause glare. Too little light or poorly placed light fixtures cause shadows on the VDT screen.

Glare and shadows cause eyestrain and fatigue. If the operator has to adopt an awkward position to see around glare and shadows, the strain can cause neck, shoulder and back pain.

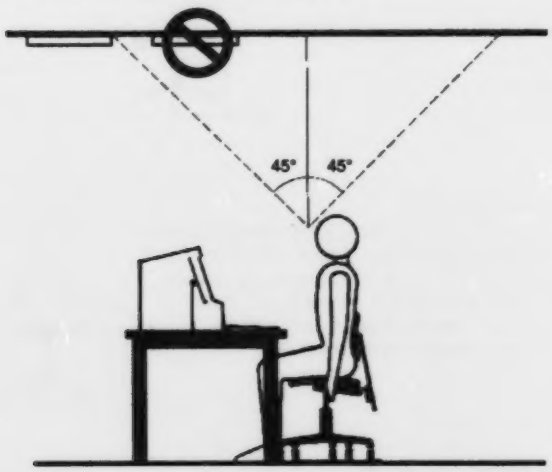
Lighting must be balanced. It must be bright enough for the operator to read source documents. It should not be so bright that it makes it hard to read from the screen. The recommended lighting level is 300 to 500 lux.

DOs

CHECK for reflections or bright spots on the VDT screen. Eliminate the source.

USE grid or parabolic filters on fluorescent fixtures to evenly disperse light. Refer to ERGONOMIC INFOGRAM E-B01.

POSITION VDT with ceiling light fixtures to the sides of the screen or at least outside of the glare zone. Refer to ERGONOMIC INFOGRAM E-B01.



POSITION VDT screen at 90° angle to windows. Refer to ERGONOMIC INFOGRAM E-B01.

ADJUST window blinds or drapes to control light levels and glare.

USE non-glare finishes and neutral colours on walls, furniture and VDT equipment.

USE glare screen or filter on VDT screen if glare cannot be eliminated at the source. Refer to ERGONOMIC INFOGRAM E-B03.

USE task lights to eliminate shadows over source documents.

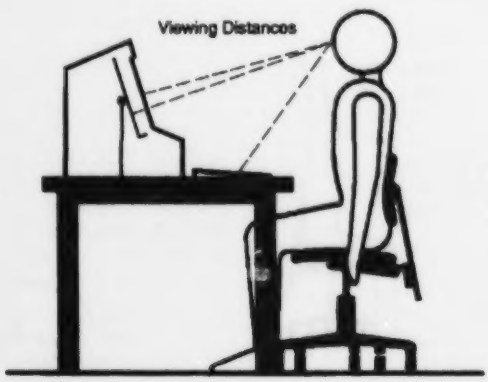
MOVE or cover shiny objects.

CHECK for flicker from fluorescent lights. Replace fluorescent tubes regularly and properly maintain fixtures.

CHECK for flicker from VDT screen.

LOOK away frequently from the VDT to rest the eyes.

ENSURE correction of vision problems by having regular eye examinations. Tell the eye examiner about VDT use and the viewing distances. Viewing distances and angles may influence the choice of lenses.



DO NOTs

DO NOT HANG glossy pictures behind VDT screen.

DO NOT USE shiny or glossy desk blotters.

DO NOT FACE windows or have VDT screen facing windows.

Available for display as ERGONOMIC INFOGRAM E-B05

APPENDIX F

Job Design

No matter how well designed a workplace is, health and safety problems arise if little attention is paid to how work is done. VDT work often involves repetitive movements of the hands and few changes in body position. This can lead to muscle pain and strain.

VARY work tasks. Break up VDT work by doing non-VDT tasks that place different demands on the body by changing body position.

WORK at a reasonable rate. Too fast a work pace contributes to muscle strain. Too slow a work pace contributes to boredom.

LOOK away from the screen occasionally and focus on a distant object to rest the eyes.

TAKE regular rest breaks to ease muscle aches, eye strain and stress.

USE rest breaks to stand up, move around and change mental activity.

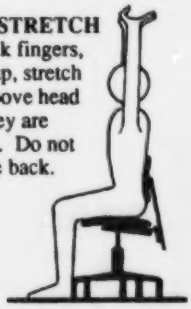
RELAX muscles, stretch and change position. Exercises done at the VDT help.

SIDE STRETCH
Drop left shoulder, reaching left hand towards the floor. Return to starting position. Repeat on right side.

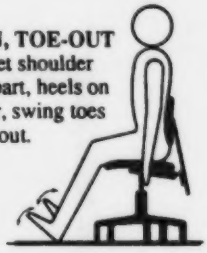
BACK CURL
Grasp shin. Lift leg off the floor. Bend forward (curling the back), reaching nose toward the knee.

ANKLE FLEX AND STRETCH
Hold one foot off the floor, leg straight. Alternately flex ankle (pointing toes up) and extend (pointing toes toward the floor). Repeat with the other leg.

TALL STRETCH
Interlock fingers, palms up, stretch arms above head until they are straight. Do not arch the back.



TOE-IN, TOE-OUT
Place feet shoulder width apart, heels on the floor, swing toes in, then out.



LEG LIFT
Sit forward on the chair so your back is not touching the chair's back. Place feet flat on the floor. With a straight leg, lift one foot a few inches off the floor. Hold momentarily, return it to the floor and repeat with the other leg.

SHOULDER ROLL
Roll the shoulders--raise them, pull them back, then drop them and relax. Repeat in the opposite direction.

PALMING *(not shown)*
Without pressing on eyeballs, cover eyes with palms. Close eyes. Breathe deeply 8 or 9 times. Uncover eyes after a few seconds. Open by fluttering them and blinking.

Available for display as ERGONOMIC INFOGRAM E-B06

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FURTHER READING

Charron, D. Health hazards of radiation from video display terminals--questions and answers. Hamilton, Ontario: Canadian Centre for Occupational Health and Safety, 1988.

Ergonomic guidelines for the selection and use of visual display terminals in Bell Canada. Bell Canada, Corporate Health and Safety, 1984.

Human factors of workstations with visual displays. 3rd ed. San Jose, CA: International Business Machines Corporation, 1984.

Stones, I. Ergonomics: a basic guide. Hamilton, Ontario: Canadian Centre for Occupational Health and Safety, 1989.

Stones, I. Job design: how it contributes to occupational health and safety. Hamilton, Ontario: Canadian Centre for Occupational Health and Safety, 1989.

Video display terminals: the human factor: reference handbook. Chicago, Illinois: National Safety Council, 1983.

Workstation design for current office environments. Des Plaines, IL: American Society of Safety Engineers, 1985. p. III-1 - IV-15.